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School Effectiveness Function: A Model Developed From Historical Reports Supplemented with Subjective Vocational Teacher Perceptions

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Abstract: A school effectiveness function based on considerations and mathematical analyses associated with Multiattribute Utility Technology was developed. The function served to unify single indicators of school effectiveness in a manner understandable to local community groups and school personnel and was capable of computation on hand held calculators with memories. The methodology has validity and reliability, intuitive efficacy, and a capacity for objectivity in providing both an empirical algorithm and a better understanding of school effectiveness. Data were collected from from 98 new educators recently employed in business

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and industry (the stakeholders) on 12 published school effectiveness attributes. Weighings were calculated from the stakeholder data and indices of relative school effectiveness were computed. The methodology is general and readily adapts to new situations.

School effectiveness. is but one essential segment of a larger, complex effectiveness. mosaic. Another essential component is teaching effectiveness (Walters & Wilmoth, 1992). Every educator realizes the mosaic extends well beyond teaching and school effectiveness to include components involving other institutional (beyond school)! social, cultural, political, economic, psychologic, and student attributes. Furthermore, the theoretical concept of effectiveness could combine elements of the mosaic into more complex patterns. A more general, yet manageable, educational effectiveness methodology, for example, could combine such component parts as teaching effectiveness from the earlier Walters and Wilmoth (1992) report and the current component on school effectiveness. These are but examples of research initiatives on which an enlarged empirical understanding of educational effectiveness may be erected.

Numerous research reports *including* A Nation at Risk: The Imperative for Educational Reform (National Commission on Excellence in Education, 1983) and Barriers to Excellence Our Children at Risk (National Coalition of Advocates of Students, 1985) have been written about school and teacher effectiveness in relation to their contribution to diminishing roles and influences of American education. Various groups such as institutes, organizations, and commissions have presented larger contexts

for a rather gloomy picture of the nation's educational system. Barth (198S) provided a typical example of the level of. concern:

> It is very distressing to find that those doing the criticizing frequently tend to overlook or completely ignore numerous variables, in and outside the classroom, beyond the control of the individual teacher, which have great impact on the learning process. (p.240)

Ralph and Fennessey (1983) and Rowan, Bossert, and Dwyer (1983) have suggested educators need dependable, reproducible process/outcome relationships (cited in Stringfield & Teddlie, 1988, p.44), before emphasizing attributes for school effectiveness. These are but a few reports implicitly providing a background supporting development of a general mathematical model for indexing school effectiveness. Such a model should enhance assessment and evaluation of schools at all levels, particularly at the secondary and postsecondary levels.

Relevant Background Literature

Researchers have studied efforts of successful administrator, teachers, and other staff to foster important educational outcomes for their studenta (Mandeville & Anderson, 1987). As indicated by Stringfield and Teddlie (1988), "we can expect refinements in school improvement from research-based models, but schools and districts already have the means for creating effective schools at their disposal--starting with determination, dedication, and common sense" (p.43).

An important question then arises: What should instructional leaders do to promote teacher and school effectiveness? Leadership was found by Barsky (1975) to be

related to (and presumably causative of) effectiveness. Moreover, organizational structure has been found to have some influence on actions of school administrators while administrators, in turn, reciprocally influenced the structure of school organization (Barsky, 1975). Until 1983, however, the covariation between leadership and effectiveness had not been adequately researched. At that time, Duke (1983) suggested that relationships between leadership functions and instructional effectiveness could be analyzed for their specific contributing influences on school effectiveness.

Six key factors, among others included in the literature encompassing instructional effectiveness, may assist administrators in establishing a climate of school effectiveness. These six factors, as indicated by Duke (19S3, p. 2), were: (a) competent teachers, (b) adequate time for direct instruction, (c) an orderly learning environments (d) adequate instructional resources; (e) communication of high expectations, and(f) continuous monitoring of progress. Successful administrative coordination and implementation of these factors would seem to require actualization of planned provisions for staff development, instructional support, resource acquisition and allocation, and quality control (Duke, 1983).

Need for Study

Since the 1950s American public schools have come under *increasingly serious* criticism. More and more students, professionals, and laypersons seem to be dissatisfied with both the objectives and accomplishments of education according to the National Commission on Excellence in Education (1983). Moreover,

> popular views of the public schools from the mass media suggest that teachers aren't teaching, students aren't learning . . . . administrators are bogged down in paper work and conflict resolution, and parents are seemingly unconcerned with or unable to affect the school's direction. (Kachel, 1989, p. 93)

One author (Kachel, 1989) suggested learning how to educate our students from the Amish since Amish. students tend consistently to "score equal to or slightly above the national norm on standardized tests" (p. 93).

While studying effective versus ineffective schools Teddlie, Kirby, and Stringfield (1989) found effective schools to include administrators with "a finger on the pulse of the school" (p.231), a visibility in the school hallways and classrooms, a continuing link to instruction by frequently teaching classes, a knowledgeable orientation to significant classroom innovations, and a commitment to expose teachers to new and creative ideas.

The most salient feature of effective schools was effective use of time. In addition, effective schools appeared to reflect Rosenshine's attributes of effective teaching (cited in Association for Supervision and Curriculum Development, 1981, Teacher and School Effectiveness). Effective schools also seemed to be characterized by other attributes such as: (a) administrators insiiing on clear academic focus, (b) teachers interested in student mastery of basic skills, (c) provisions for symbols of academic excellence (i.e., achievement recognition programs), and (d) emphasis on interactive teaching.

Despite improved insights concerning correlates with effectiveness, a need to better understand their unified operation persists. With so many indicators of school effectiveness, an approach to unifying the indicators in a manner understandable to

local community groups and school personnel is essential. Also essential is a methodology having validity and reliability, intuitive efficacy, and a capacity for objectivity. Such a methodology resides in the technology associated with the School Effectiveness Function (SEF) described in a following section. The SEF was conceived on the basis of the considerations and mathematical analyses described by Edwards and Newman (1982) under the label of Multiattribute Utility Technology or MAUT technique.

Business and Industry Personnel Seeking Teacher Certification

Conventional wisdom in political and media circles seems to suggest, from national to local levels, that business persons and industrialists are in a better position to recognize school effectiveness than educators. Under that assumption it seemed efficacious to include data from educational personnel recently active in those professions in any search for a school effectiveness function.

Methodology

The methodology for this school effectiveness study parallels that reported earlier on teaching effectiveness (Walters & Wilmoth, 1992). A SEF similar to the earlier reported Teaching Effectiveness Function (TEF), therefore, is defined below for aggregating au arbitrary number of weighted component attributes of school effectiveness. The methodological sequence was implicit in requirements of the MAUT technique: (a) the component attribute of school effectiveness needed to be isolated, (b) a stakeholder group needed to be defined, and (c) a methodology for assigning weights to the attributes needed to be developed. The weights served to differentiate the relative

contributions of the component attributes to the phenomenon known as School Effectiveness.

Instrumentation for the Attributes

An instrument was designed around a set of published school effectiveness dimensions/attributes. The instrument consisted of two parts: (a) demographic items, and (b) the school effectiveness items. The. fii part addressed 7 demographic characteristics for those responding to the request for data. The demographics for the educator stakeholders were age, educational level, gender, teaching status (teaching or not teaching at present time), years teaching at secondary level, years teaching at postsecondary level, and number of children (in the family) currently enrolled in educational programs at various levels.

Any set of component attributes for school effectiveness could have been selected to complete the instrument. For the current study, the second or school effectiveness part of this instrument consisted of 12 statements identifying assumed characteristics of school effectiveness. These items were "based upon interpretations of research by Ronald Edmonds, Peter Mortimer, Barak Rosenshiie and others" (ASCD, 1981, p.19) and were published by the Association for Supervision and Curriculum Development (ASCD) in 1981. The validities of the 12 statements were assumed; therefore, they were not tested. Their reliability coefficient (standardized alpha) when linked to the common scale described next and computed from the stakeholder data was .74.

The Common Scale. The common scale for the 12 items was selected to parallel the scale for the teaching effectiveness items already reported. That is, its selection was

based on a need for comparability of stakeholder responses so that teaching effectiveness and school effectiveness could be treated in an enlarged context of educational effectiveness. As shown in Figure 1, respondents were asked to rate their perceptions of the level of importance for each item on a 5-point scale ranging between 1 = not important, and 5 = very high importance. Differential contributions to school effectiveness of the items were defined from weighings developed from. statistical considerations as described in the statistical methodology.

Stakeholder Subjects

The 98 subjects had either been employed recently to teach or were preparing to teach in secondary and postsecondary industrial or postsecondary health occupations education programs. The subjects were enrolled in courses required for teacher certification. Twenty-five were female, 70 were male (gender was not known for 3); 72 were currently teaching and 26 were preparing to teach. Those having teaching experience at the secondary level averaged 0.526 years and those at the postsecondary level, 0.534 years.

By educational background, 20 subjects had completed high school and 16, a one-year technical program; 19 had an associate degree; 26 had a four-year college degree; and 4 had a masters degree. Nine subjects had completed only the specified courses for a non-professional type of teacher certification. Four had completed various other types of educational training. The majority (65) had children enrolled in educational programs at various levels. Twenty-six had children in elementary school, 10 in middle or junior high school, 17 in high school, and 12 had children enrolled in college.

The Effective School

Instructions: Rate the following items according to level of importance for school effectiveness. Use the following scale to guide your response.

An effective school:	Levels of Importance 5 = Very High, 4 = High, 3 = Average, 2 = Low, 1 = Not Important

_ 1. has strong leadership, especially in reading and math instruction.

___ 2. provides a pleasant and orderly atmosphere; the classroom climate is business-like with teacher-directed student activities.

__ 3. expects all students to learn.

_ 4. makes learning the chief priority; all staff members understand this emphasis.

___ 5. monitors student progress carefully, reports test results, and uses them to improve teaching and learning.

_ 6. gives students adequate time on task and opportunity to learn expected content.

__ 7. stresses rewards rather than punishment.

_ *8. is* committed to mastery of subject matter; insists that each student succeed before moving onto the next unit.

_ 9. has high expectations for teachers as well as for students.

___10. encourages and facilitates visits of teachers to other teachers' classrooms to observe techniques and amount of time on task.

__ 11. maintains consistency among teachers in treatment of students.

___12. gives adequate feedback so students know what they have learned and what still needs to be learned.

"Based upon interpretations of research by Ronald Edmonds, Peter Mortimore, Barak Rosenshine. and others" (ASCII, 1981, p.19)

Figure 1 continues

Note. Items are from Teacher and School Effectiveness: Teacher's Guide (p. 19) by Dorothy Mulligan, 1981, Alexandria, VA Association for Supervision and Curriculum Development. Adapted by permission.

Figure 1. ASCD items on "The Effective School" presented as items 27 through 38 of the opinionnaire for computing SEF weighings.

These subjects were of interest because of their recent connections with the worlds of business and industry. However, for the current study, they could have represented any group with an interest/stake in the area of school effectiveness. The methodology is independent of the population represented.

Data Collection

Data were collected from individuals who either had recently been employed as new teachers or were planning for a teaching career. All 98 teachers or prospective teachers were former business and industry personnel who were enrolled in one of the education courses required for teacher certification. The courses included three components related to school effectiveness: (a) lecture, (b) film, and (c) activities in group discussion and problem solving.

The fihn waa reported to bean "effective means for helping students acquire knowledge" (ASCD, 1981, p.5) about school effectiveness (Part II of the film). Group discussion and problem solving were employed to facilitate comprehension and application of content related to effectiveness of schools. The same procedures were used in each class to insure that each received similar treatment. At the conclusion of the school effectiveness instruction in the three areas, each participant completed the questionnaire.

Statistical Methodology

Given the set of 12 attributes published by ASCD as indicators of school effectiveness for a group of stakeholders laid out in a data matrix such as in the data elements part (the 98 rows) of Figure 2, the problem became one of how to composite their measures into a more manageable, smaller number of scores in a limited set, or into a single composite score. One approach to the problem having a relatively long history in educational data analysis could have been factoring into the essential dimensions and computing principal components or factor scores. In factoring, weighting coefficients for each attribute would be objectively determined from the subjective, empirically reported stakeholder responses.

Another approach (the one used here) involved linear compositing of the 12 measures into a single score. The recommended approach by Edwards and Newman (1982) for single score compositing begins with establishing a possibly subjective ranking for the 12 attributes of school effectiveness. These rankings were derived from the average ratings assigned independently by the stakeholders to the attributes on the 1 through 5 scale of importance. The 12 rating averages were converted into attribute ranks with the highest average rating receiving the rank of 12 and the lowest the rank of 1. These 12 ranks were then normalized (Edwards & Newman, 1982, p. 54) such that they totaled 1.00. The normalized values were the observed attribute weighings. If applied to single attribute values on a scale of 1 through 5, the observed weighings incorporated into the SEF would produce school effectiveness scores on a 1 through 5 scale comparable to the initial scale of importance to which the stakeholders responded.

Stake-holders (i)	Attribute Item (j) 1	2	. . .	k=12	Σa_{ij} (j=1 to k)	$s*\Sigma a_{ij}$ (j=1 to k)
1						
2						
3						
.						
.						
.						
n=98						

a_{ij}

RAW SCORES

STANDARDIZED SCORES

$\sum_{i=1}^{n} \Sigma a_{ij}$

Grand Total = $\sum_{i=1}^{n} \sum_{j=1}^{k} \Sigma a_{ij}$

Observed weighting coefficients = $\Sigma a_{ij} \Big/ \sum_{i=1}^{n} \sum_{j=1}^{k} \Sigma a_{ij}$

Scaled weighting coefficients = S * (Observed weighting coefficients)

[S is scaling factor]

Figure 2. A schematic showing relationships between raw data, observed and scaled weighting coefficients, and aggregate scores. The scaling factor is 20.

The set of weightings could be modified for the School Effectiveness Function to produce scores on any arbitrary scale. A modified scale of school effectiveness having a maximum value of 100 was elected for its obvious intuitive appeal. The derived weighting for each attribute from the stakeholder data set was multiplied by 20 to change the school effectiveness score maximum from 5 to 100.

The School Effectiveness Function. Having a set of school effectiveness attributes with their respective weights one uses MAUT mathematics to produce for a school its SEF score with higher scores indicating higher levels of school effectiveness. The rank sum weight option of Edwards and Newman (19S2, pp. 53-5.5) was used to derive observed and resealed weights from rank orderings of the attributes by all stakeholders. The weights were treated as coefficients and were used to multiply respective school attribute scores in the MAUT equation for the SEF:

$$SEF = \Sigma (Weight)_i * (Attribute)_i$$

The School Effectiveness Function is the sum (SEF aggregate) of the attribute value multiplied by respective weighting value for all the single attribute. School effectiveness of a particular school would be indexed, in practice, by first assigning a value between 1 and 5 to each of the 12 attribute dimensions for a respondent (say a teacher who responds to the 12 items in a manner to reflect judgments about the school), matching each single attriiute judgment with its weighting coefficient and multiplying, then aggregating (as specified in the School Effectiveness Function) the

products of the 12 assigned pairs of values. Most hand-held calculators with memories are capable of these mathematical operations.

Each respondent evaluated the contributing importance of each of the 12 items to effective schooling. Respondents were not required to order or otherwise distinctly separate the items. Thus, one should analyze the data, interpret the results, and draw conclusions accordingly. In practice, one should keep in mind that the data, by the controlled nature of the situation from which they were collected, defined subjective views of effective schools. If subsequent users wished to compare (with these outcomes) outcomes from a new administration of the data to a new group of respondents, the comparison would yield statements concerning school effectiveness (i.e., falling in the distribution determined here) or ineffectiveness (i.e., falling in the range whose values are equal to or greater than 2 standard deviations below the mean).

Results

Weightings

The SEF itself, as was the Teaching Effectiveness Function previously reported, is based on multiattribute evaluation techniques (described by Edwards and Newman, 1982, p.8) from Multiattribute Utility Technology (MAUT). Application of these techniques to the stakeholder data as described in the preceding methodology section generates the observed and scaled weighings in Table 1. The weighings vary over a relatively narrow range indicating that each of the single attributes carried about the same importance in the judgments of the stakeholders measured.

Table 1

Observed and Scaled Weightings for the 12 School Effectiveness Items

Item No.	Weight		Item No.	Weight		Item
	Observed	Scaled		Observed	scaled	
1	0.0850535	1.700	7	0.0837156	1.674	
2	0.0848624	1.696	8	0.0800841	1.600	
3	0.0863914	1.726	9	0.0867737	1.734	
4	0.0879205	1.758	10	0.0716743	1.432	
5	0.0852446	1.704	11	0.0808486	1.616	
6	0.0844801	1.688	12	0.0829511	1.658	

Table 2 presents distribution properties for SEF (aggregate) scores computed from the 98 stakeholder ratings on the single school effectiveness attributes with their scaled weighting coefficients as relative school effectiveness indices.

Discussion, Implications, and Recommendations

An Instrument for Auditing/Monitoring School Effectiveness in Vocational Education

From the distribution properties of Table 2, one easily could derive at least three arbitrary levels of standards for distinguishing among effective schools based on the collective judgments of the stakeholders in this study. The same item attributes under a different set of anchored values, say a set anchored as described in Figure 3 could

produce similar ratings. Three levels of standards are described in the following paragraphs to illustrate the proses:

Table 2

Distribution Properties for Aggregate Scores from the School Effectiveness Function

Percentile	Value	Percentile	Value	Percentile	Value
10.00	79.869	50.00	90.101	75.00	95.018
25.00	83.824			90.00	98.558

Valid cases 98 Missing cases 0 Std Dev 7.245

RELIABILITY COEFFICIENTS 12 ITEMS

ALPHA = .7375 STANDARDIZED ITEM ALPHA = .7462

1. The most stringent standard could be based on ratings at the 90th percentile or higher. That is, an SEF score (rating) derived from the 12 item instrument and computed from the weighting coefficients described in the foregoing would need to be larger than about 98 to be considered as highly effective. In other words, there could be but one single attribute dimension, of the 12 rated, on which the school could be rated less than 5.

Practices in School

Instructions: Rate the following items according to level of practice for the school being assessed. Write the appropriate response in the blank to the left of each item.

	Levels of Practice 5=Exceptional, 4=Above Avg, 3=Average, 2=Below Avg, 1=Unsatisfactory
The school being assessed	

Figure 3. Substitute title and instructions for instrument to evaluate school effectiveness.

2. An intermediate standard might be tied to either the 25th, 50th, or 75th stakeholder percentiles. Suppose one choose the 50th percentile. That standard would require an SEF score larger than 90 for consideration as at least a moderately effective school. One way for a school to have attained that standard in the mind of a typical evaluator would be to have a rating of 5 on at least 5 of the single attributes aud a rating of 4 on the balance. Should any single attribute have been rated less than 4, more than 5 ratings of 5 would be required for the school to be judged as moderately effective.

3. The least stringent standard from the distribution data presented in Table 2 could be tied to the 10th percentile value of about 80 with a corresponding rating of marginally effective. Interpreted in one way, a minimum score of 80 roughly could be achieved by 3 attributes rated 5, 5 attributes rated 4, and 4 attributes rated 3.

A fourth evaluation level indicating ineffectiveness would follow for schools lying below the 10th percentile. SEF scores smaller than 80, by this scheme, would indicate degrees of ineffectiveness with smaller values indicating ever lesser levels of effectiveness (i.e. increasing ineffectiveness).

Educational Policy

Educational policy should be driven, at least in part, by empirical information collected from those the policy would influence. One could derive weighting coefficients separately for each group of affected stakeholders in schools or one could apply a common set of weighings to all affected groups.

Involvement of Other Evaluators

One immediately thinks of a variety of publics having an interest in school effectiveness. Each could enter the process as a stakeholder group for which weighting coefficients could be computed. Each could serve also as an evaluator group for assigning single attribute values that would be entered into an existing SEF for which weighings had already been established. The interested publics could include, but not be limited to: (a) the members of a local school board, (b) administrators, (c) teachers, (d) students, (e) local political leaders, (f) parents, and (g) business and industrial leaders.

General Interpretation

One should be alert in interpreting research for the potential influences of changes in instrumentation population, or methodology. In the present case, changes in instrumentation would affect the precise meaning carried by the concept of school

effectiveness. In this study, school effectiveness means precisely what ASCD broke it down to mean in their 1981 publication. Changes in the population would suggest a different group of stakeholders from whom relative weighings of the single attributes were defined. It would be most unlikely for a different set of stakeholders to assign weights such that the relative rankings of the attributes (thus their corresponding weights) would remain the same. In the full spirit of MAUT techniques it is not necessary to determine the relative rankings of the single school effectiveness attributes from empirical rating methods as was done here. In fact, MAUT would allow, moreover it encourages, rankings of the single attributes by each stakeholder with differences in assignments resolved through discussions leading to consensus. Such a change in methodology likely would change the weighings to be applied with the SEF. Changes in instrumentation, population/stakeholders, or weighings probably would influence distribution properties, thus would require new, perhaps radically different, interpretations for operative school effectiveness standards such as those presented in the foregoing.

New Research

Even though broad-based "efforts to promote excellence-or at least adequacy--in public schooling is now more than 10 years old " (Sewall, 1991, p.204), it seems that research related to effective schooling should be an on-going process. However, according to Gough (1991):

> "Reshaping our schools is akin to solving a 500,000-piece, multidimensional jigsaw puzzle. Everything influences everything else. And, if we aren't careful, some of our actions may be counterproductive." (p. 179)

President Bush could be thanked by the American public for claiming education to be his administration's top priority choice on the domestic agenda. The president seemed also to have hit a target with his remarks about America 2000 (1991):

> Think about every problem, every challenge we face. The solution to each starts with education. . . . Across this country, people have started to transform the American school. They know that the time for talk is over. Their slogan is: Don't dither, just do it. (Gough, 1991, p. 179)

However, according to Clinchy (1991):

> America 2000 pays precious little attention to the crucial question of how the billions of dollars needed to turn all these ideas and proposals into reality will be provided. While it is certainly possible for school districts to implement many structural reforms without spending large amounts of money, America 2000 offers little to support the initiatives it endorses beyond the $120 million to $150 million to be raised from the private sector. (p. 211)

The spirit, if not the complete substance, of America 2000 lives on. According to NEA NOW (May 10, 1993), President Clinton had unveiled two initiatives to improve American education. The first initiative (the one most relevant for this study):

> . . . Goals 2000: Educate America Act, is designed to help states and localities meet the six National Education Goals adopted by the nation's governors. The Act

would, among other things, establish a Goals Panel to build consensus for education improvement and a Standards and Improvement Council to develop and certify voluntary national standards for what students should know and be able to do.

Whatever initiative may develop, the model addressed in this paper could assist school personnel in conducting further research to evaluate, revise, and improve effectiveness of schools.

Follow-up

School effectiveness may be considered as but one segment of a larger, complex effectiveness mosaic involving institutional, social, cultural, political, economic, psychologic, and student attributes. Earlier (1992), Walters and Wilmoth focused on teaching effectiveness as but one level-a personnel contribution--to the mosaic. A follow-up report will present a more general educational effectiveness methodology capable of reducing the complex mosaic into a manageable synthesis of component parts of which teaching effectiveness and school effectiveness are but two examples of research initiatives.

New research should also provide for more objective measures of the phenomena involved--of student learning, of teaching effectiveness, of school contributions to educational effectiveness. While teacher perceptions may be important, they may be, nevertheless, self-serving.

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